Possible Clinical Application Questions for Exam I

1. Blood Pressure drops when a person goes from a lying to standing position. In order to correct the decreased drop in blood pressure the body uses mechanisms to increase blood pressure. Do these mechanisms use positive or negative feedback processes? Describe how the body responds to correct this situation.

Correction of blood pressure in this situation is an example of a negative feedback process because the initial change (decreased blood pressure) is corrected by the response (increased blood pressure) which reverses the direction of the initial change.

When you stand up, gravity causes blood to settle in the lower part of your body. Blood pressure receptors known as baroreceptors (sensors) detect the change in blood pressure. Baroreceptors are specialized sensory neurons in the walls of the aortic arch and the carotid sinuses that measure the degree of stretch in the vessel wall. Information is sent from the baroreceptors to the medulla oblongata via sensory nerves. The Medulla oblongata (control center) analyzes the change in blood pressure and sends a nerve impulse to the heart and blood vessels (mainly arterioles), both of which are effectors, to correct the decrease in blood pressure.

- Heart rate and amount of blood pumped are increased causing an increase in blood pressure
- Vasoconstriction of arterioles increases blood pressure.

Thus if BP is too high or too low, a reflex change in cardiac output is initiated in order to correct it.

2. It is determined that a patient is in acidosis. What does this mean, what is the normal pH range for the human body, and would you treat the condition with a chemical that would raise or lower the pH?

Acidosis means blood pH is below the normal range. Normal pH range is 7.35 to 7.45. The patient should be treated with something to raise the pH.

3. You overhear a group of teenagers betting each other as to who could drink the most water within a 30 minute time span. Being the excellent medical student that you are you interrupt them and explain the dangers of drinking seemingly harmless liquid (water) in such a short period of time. What is your explanation?

Drinking water is hypotonic to the cells of your body. Taking in too much water in a short period of time will cause the blood and eventually the interstitial fluid to become hypotonic to the body cells. The extracellular water will then move by osmosis into the body cells and cause them to rupture. This could, and has in the past, kill a person.

4. Your friend tells you that he is taking the antibiotic streptomycin for an infection. He wants to know how this particular antibiotic can kill bacterial cells but not kill his own cells. What is your explanation?

Streptomycin inhibits bacterial protein synthesis by interfering with ribosomal function of bacteria and has no effect on the ribosomes of humans. If the bacterial are unable to synthesize new protein (many of which would be essential enzymes), they will die.
5. The events of childbirth are associated with the process of positive feedback. Describe the events which confirm this statement.

**Stretching of the uterus by the developing fetus stimulates the start of contractions.** Contractions push the baby toward the opening of the uterus, causing additional stretching which initiates more contractions. **Stretch receptors in the uterine wall are monitored by the hypothalamus of the brain.** As the uterus stretches the hypothalamus releases **oxytocin via the posterior pituitary gland**, which causes the uterus to contract. This contraction further distorts the uterus resulting in more oxytocin to be released which increase uterine contractions. The **cycle continues until the baby is delivered** and the stretching stimulation is eliminated.

6. How can the rapid breakdown of fat result in a dangerous decrease in blood pH?

**Hydrolysis of triglycerides** within adipose tissue releases **glycerol and free fatty acids into the blood** which are both used as an energy source in many organs; they can also be converted by the liver into derivatives called **ketone bodies** which circulate through the blood and used as a an energy source. Ketone bodies include **acetoacetic acid, β-hydroxybutyric acid, and acetone (solvent in nail polish remover)**. A rapid breakdown of fat (lipolysis), as may occur during low-carbohydrate diets and in **uncontrolled diabetes mellitus**, can result in elevated levels of ketone bodies in the blood – a condition called **ketosis**. If there are sufficient amounts of ketone bodies in the blood to lower the blood pH, the condition is called **ketoacidosis**. Severe ketoacidosis, which may occur in diabetes mellitus, can lead to coma and death. A person in this condition may also have a **sweet-smelling breath due** to the presence of **acetone**, which is volatile and leaves the blood in the exhaled air.

7. In a hospital, a nurse gave a patient recovering from surgery a transfusion of 5% salt solution by mistake instead of a transfusion of physiological saline (0.9% salt). The patient quickly went into shock and soon after died. What caused the patient to enter into a state of shock and die? Be sure to comment on what functions where disrupted to cause death.

Because of the increase of solute concentration in the blood stream, it became **hypertonic to the RBCs**. The **RBCs dehydrated and shrank – crenation**. The crenated RBCs lost their oxygen-carrying capacity and the body tissues were deprived of the oxygen necessary of cellular metabolism to support life.

8. One remedy for constipation is a saline laxative such as Epsom salts (MgSO4). Why do such salts have a laxative effect?

Epsom salts **increases the solute concentration in the lumen of the large intestine** making the intestine **hypertonic** to surrounding tissues. The **osmosis** of water occurs from the surrounding tissues into the intestinal lumen. The **fluid helps soften the stool** and the watery environment prepares the intestine for eventual evacuation of the stool from the bowel.
9. Using insulin as an example, explain how the secretion of this hormone is stimulated and the mechanism by which its secretion is turned off. Is this a positive or negative feedback mechanism?

A rise in plasma glucose concentration stimulates insulin secretion from the beta cells that are contained within the structures in the pancreas known as the pancreatic islets (islets of Langerhans). Insulin stimulates the upregulation of GLUT 4 transporters into the cell membrane that allows blood glucose to be taken into the body cells by facilitated diffusion. The lowering of blood glucose which due to insulin’s action inhibits further insulin secretion. This process is negative feedback mechanism because the original stimulus, rise is blood glucose, is reversed.